The African Organisation for Standardisation

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AFRICA CODES OF PRACTICE FOR SHEA KERNEL AND SHEA BUTTER

Introduction

Shea is a tree unique to sixteen countries within the shea belt of Africa and is the source of shea kernel from which shea butter is obtained.
Pure unrefined shea butter has nutritional, medicinal and moisturizing properties leading to its increased demand locally and internationally for use in the confectionary, cosmetic and pharmaceutical industry other than food.

Shea butter has inherent characteristics such as high levels of total fat, antioxidants, unsaponifiables and it is important that these characteristics are maintained and aspects related to quality deterioration such as high moisture content leading to free fatty acids, peroxide value, odour etc are critically addressed to realize the competitive advantage of this important commodity/ product.

Different primary processing methods exist across the shea belt and studies have shown that some of these methods have an effect on the important inherent properties and so can the handling practices during harvesting, storage and drying effect the product quality.
This African Codes of Practice for Shea Kernel and Shea butter is therefore being developed with an objective to preserve the inherent characteristics of shea butter during processing and assure quality during harvesting, storage and drying.

The Code is based on the best processing practices from 16 countries within the shea belt with reference to best practices of post harvest handling. It defines critical techniques and control points that must be improved and adhered to, so as to ensure quality that would satisfy industrial and consumer requirements of the relevant standards.

Foreword

The African Regional Organization for Standardization (ARSO) is a continental organization which harmonizes the standards developed by member countries and it's regional blocks. After the harmonization process member countries are then to publish the standards.
The African Regional Organization for Standardization is a member of the International Organization for Standardization (ISO).

The elaboration of this Africa Codes of Practice was carried out through a Regional Technical Committee drawn from the National Standards Bodies from the shea zone. Draft standards in the producer countries were widely circulated for public review and consultations (with direct involvement of the private sector and industry) both national and international, in order to assess and record the perspectives of a wide variety of stakeholders. The harmonisation process was done based on the African harmonisation model.The results of national consultation work was presented, reviewed and finalized at a regional inter-governmental consultation before recommending the standard to ARSO for declaration as Africa Standard.

This Codes of Practice has been elaborated with a view to serve as a reference for the processors as well as the professionals of the sector, consumers and institutions engaged in research, analysis and enforcement, in the framework of application of quality requirements to facilitate national, regional and international trade in shea kernel and shea butter.
Reference to national and international publications as well as work of private sector and industries are hereby acknowledged.

Information on the processing of shea kernel and shea butter as well as implications of Processing Methods by Quality Parameters towards a Standard Operating Procedure (SOP) is included in an Annex.

Users should note that these codes of practice undergoes revision from time to time and any reference to it statutorily implies its latest edition.

1.0 Scope

This Africa Codes of Practice for shea kernel and shea butter describes recommended practices during harvest, drying and storage of shea kernel and primary processing into shea butter.

2.0 Normative references

The following references contain provisions applicable to this Standard. At the time of publication, the edition indicated was valid.
All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the recent edition of the standard indicated below.

Africa standard for shea butter

3.0 Terminology

For the purposes of this Code of practice the terminologies in the Africa Standard for Terminology for sheakernel and sheabutter shall apply.

4.0 Preparation and Storage of Dry Kernel

4.1 **Collection** or **picking** the mature shea fruit from the ground beneath the tree. The fruit should be fully mature, yet un-germinated fruit (nut colour being brown as opposed to having a 'white' appearance, and sweet, edible fruit without the presence of copious latex and the seeds without evidence of the emergence or a pseudo-radicle).

4.2 Accumulation: Harvested fruit or nuts should be ***accumulated*** (***heaped***) either in the field and/or at the homestead not more than three days

4.2.1 Depulping

Fruits should be sorted, depulped by any means that will not damage the nuts

4.4 Washing

The depulped nuts should be washed.

4.5 Heating and Drying

The process of stopping enzymatic browning can be done either by heating or drying :

4.5.1 Heating

Boiling of washed nuts should be done with clean water using stainless steel or clay pots for between 30 – 40 minutes (from when it starts to boil). Covering of the pot should also be done using stainless steel or clay covers. (Heating can be done in an enclosed oven without smoke)
Boiling should not be done by smoking or other methods except the ones specified above.

4.5.2 Drying

Whether unboiled or boiled nuts, drying should be done by spreading boiled nuts on mats on raised plateforms in the sun or by using solar dryers .Drying should be done quickly and efficiently until nuts rattle on shaking.

4.6 Cracking of nuts

Cracking is done manually or mechanically without damaging the nuts
a de-husking (***de-cortication***) step after a few days to facilitate more complete desiccation of the shea kernels. It is at this point (moisture levels of about 5-7%) that the fully dried shea kernels are now marketable, whether for local use or international export.

4.7 Sorting of kernels

Sort to remove black coloured, infested, broken kernels and kernels with other defects.

4.8 Drying of Kernels

Drying should be done by spreading kernels on mats on raised platforms under shades (canopies).

4.9 Storage

The final stage after completion of drying and prior to the extraction stage is the ***storage*** of the dry kernel. Storage is usually done in traditional granaries or in jute sacks (food grade and free of hydrocarbons) but may sometimes be in baskets or clay pots.

4.10 Triage

In order to preserve the quality of dried shea kernel in storage, the product should be brought out for regular visual inspection, involving emptying the storage vessel on tarpaulin/mats (provided they are cleaned regularly or kept clean) and exposing to air as to reduce moisture levels. During inspection, all damaged or infested kernels (whether by insect, fungus or bacteria) should be separated and discarded in a process known as ***triage***.

5.0 Preparation of Shea Butter

5.1 Cleaning: In preparation for later extraction stages, the best dry shea kernels should be selected or dirty ones ***cleaned*** (by washing in clean water) and sun-dried prior to extraction.

5.2 Breaking

5.2.1 Pounding or Crushing: The cleaned kernels are then ***broken*** into a coarse flour either by hand-pounding or with a pestle in a mortar or using a mechanical 'crusher' as used in West Africa, powered manually or by a diesel or electric engine

5.2.2 Grinding: In the semi-mechanised modern method used in Eastern Africa, a plate-grinder or 'maize mill', powered by a diesel engine is used twice to reduce the kernel fragments to a fine flour prior to heating.

5.3 Heating

5.3.1 The kernel pieces/powder is then commonly subjected to an intense ***heating*** stage. The pieces/ powder is usually placed in a large pot (of clay or stainless steel) and regularly stirred over fire until all moisture has evaporated and the material may be roasted and occasionally singed. Mechanical roaster made of stainless steel is preferable.

5.3.2 Kernel pieces or flour are roasted using mechanical roasters (of stainless steel) until brittle and dark.or cold-pressed with mechanical pressers . This has the potential to reduce PAH's Mixing of kernels with sand or ash should not be encouraged as this has the potential to result in a high degree of shingling and burning of kernels.

5.4 Grinding or Milling: Once heated thoroughly, the shea kernel pieces are then turned into as fine paste or flour as possible, either by the traditional method of pounding in a pestle and mortar (may be followed by ***grinding*** by hand on a stone quern) or by the more recently adopted method of ***milling*** (using the common stainless plate-grinder or 'maize mill', powered by a diesel or electric engine).

5.5 Extraction

5.5.1 Aqueous extraction is then traditionally performed by mixing the paste or powder with water and processed by one of the methods described below:

5.5.1.1 In West Africa, this mixture is worked by hand in a basin of water, adding hot and cold water in steps and ***kneading*** by hand until an emulsion is formed on the surface (in some areas, notably the paste and water are worked in a mortar using a pestle). The emulsion is then ***rinsed*** several times, and heated to break the emulsion and thus separate the lipid fraction, which is decanted and heated a second time to remove residual moisture.

5.5.1.2 In eastern and central Africa, the paste or flour is added to a pot of hot water and boiled vigorously for 1-2 hours, until the oil separates and floats to the surface, from which it is scooped or decanted. The hot oil is often heated a second time in order to remove all traces of residual moisture.

5.5.2 Mechanical extraction

Mechanical extraction should include the following:

5.5.2 1. The use of a manual bridge-press (force applied by turning a threaded shaft through a screw-block, or by a hydraulic ram)

5.5.2 2. The use of a mechanical expeller with a horizontal screw, often with a steam-jacketed top-kettle for heating the whole dry shea kernel above 80 °C prior to extraction.

5.6 Clarification: Traditionally the liquid oil is normally subjected to a series of ***cleaning*** or ***clarification*** stages in order to remove any remaining residue or other impurities, by decanting the hot oil, additional washing with clean water (followed by more boiling steps) and filtering through fine muslin cloth or other suitable material

5.6.1 Wet boiling: while in liquid form, either pure or as broken emulsion, the butter may be boiled for a time (15 to 30 minutes) in order to 'scrub' kernel fragments, excess kernel phenolic compounds (appearing as a foaming purple 'dye') and other water-based impurities

5.6.2 Dry boiling: Whether as a fat-emulsion or extracted liquid oil, shea butter is then typically subjected to a ***dry boiling*** stage in order to dry the fat or oil (to remove any water to below 0.25%). When processed on a larger scale, (after mechanical extraction) this stage is normally performed under vacuum to reduce energy costs and to further prevent the oil being subject to high temperatures.

5.7 Filtering : clarification is the removal or separation of impurities from the liquid oil by heating while filtration is the process of passing the already clarified oil through a special device e.g. muslin cloth to remove unwanted materials

5.8 Conditioning: Having produced clean, dry shea butter (usually in a hot and liquid form) the final step is ***conditioning*** to prepare the butter for storage, consumption or sale. Occasional stirring while the liquid butter is cooling prevents crystallization and ensures a uniform and smooth (non-crystalline) consistency.

5.9 Packaging: Packaging of sheabutter should be in conformity with the appropriate sections of the African Standard for sheabutter.

ANNEX A

While the seed is alive and healthy, chemical processes associated with germination will occur (metabolism of the seed's stores of oils and fats starting with hydrolysis by lipases) that will increase free fatty acid (FFA) levels in the germinating seed.

Due to the presence of lipase enzymes in the living shea seed, the primary quality objective in post-harvest processing is to quickly kill and dry the seed in a controlled manner and produce a dry kernel that is chemically stable and can be stored without further chemical processes affecting the lipid content.

The time between fruit drop and the heating and/or drying stages will have a major influence on both total available lipids (fat content of the kernel and oil quality parameters (such as Free Fatty Acid, Peroxide Value, Moisture and Insoluble Impurities).

The duration of this stage should thus be minimised in the interests of product yield and quality as defined by acidity or Free Fatty Acid (FFA) content.

Boiling of the fresh nuts denatures the proteins binding the fiber and holding the moisture and lipids, thus making the fresh nuts easier to dry, and increasing the availability (yield) of total fat content in extraction - particularly of the stearin fraction, using traditional manual aqueous extraction methods.

In denaturing the lipase enzymes which may cause oxidation of kernel lipids during germination of the living seed, boiling can also reduce FFA, but can increase susceptibility to development of peroxides (see below), possibly through inhibition and/or reduction of phenolic antioxidant compounds in the kernel.

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Recent results from chemical studies on processing methods and product quality conducted by the World Agroforestry Centre (ICRAF) and the *Institut d'Economie Rurale* (IER), Bamako indicate that the heating stage also degrades plant phenolic compounds which have a protective anti-oxidant effect protecting seed lipids from oxidative degradation (Maranz et al., in press).

Recent research on the aromatic or volatile compounds present in shea butter of certain origins (Krist et al. 2006) raises the possibility that certain peroxides or related compounds resulting from the boiling stage (or other chemicals formed at this boiling stage) may be the cause or precursors of malodorous compounds.

For example, the well-known 'unpleasant' odour of shea butter produced in Ghana is not apparent when the boiling stage has been excluded. It may also be possible that other specific precursor compounds produced in higher concentrations in the western varieties are converted into malodorous molecules. This is suggested because this characteristic odor does not occur in butter produced from boiled kernel of the eastern varieties (*Vitellaria paradoxa* subspecies *nilotica*).

An alternative heating method (which cannot be recommended) consists of smoking or steaming fresh nuts on a rack of wooden sticks secured into the top of a large 'traditional-oven' for 3-5 days. Sheanut should never be exposed to smoke as this will result in contamination by polycyclic aromatic hydrocarbons, some of which are highly carcinogenic (Luch, A. (2005), and all of which are now highly prescribed by European Union import regulations.

Drying boiled shea nuts during the rainy season (under ambient temperatures which can exceed 30 °C, and humidity greater than 65%) since they are now dead - with both natural fungicides as well as lipases activated - and therefore they quickly become infected with a range of moulds and fungi. This can result in a range of chemical quality issues - notably increased levels of FFA, other volatile chemicals with unpleasant odors as well as the potential formation of aflatoxins from the *Aspergillus* fungus.

The only way to reduce these fungal problems is to ensure boiled nuts are dried quickly and efficiently, *e.g.* on wooden drying racks or inside solar-dryers (tunnels of clear rubber sheeting has been found to be very effective).

Great care must be taken during the drying stage to prevent contamination of the drying kernel with animal faeces, chemicals (including fertilizers, pesticides, petroleum products) etc.

Protection of the drying nut from all forms of contamination has relevance to organic certification, and European industrial processors have long complained about high levels of silica (sand) and other foreign bodies (nails, cans, sticks, pot fragments, etc) tin imported shea kernel, which can cause very expensive problems when the kernels are processed by modern high-tech equipment.

In some communities, shea nut is dried stored intact, a method which is credited by its adherents to keep shea kernel clean and with at least minimal protection from insect infestation. Clear disadvantages of this method include tendency to fungal bloom, presumably from systemic (endogenous) fungal spores, particularly if the fresh nuts have been subject to a heating phase as per Stage 1.3 above.

One reason seeds may be kept intact is to protect them from smoke used in wood- fire based drying methods. As mentioned above, sheanut should never be exposed to smoke as this will result in contamination by polycyclic aromatic hydrocarbons, some of which are highly carcinogenic (Luch, A. (2005), and all of which are now highly proscribed by European Union import regulations.

Jute sacks should be food-grade and hydrocarbon-free, as the poly-aromatic hydrocarbons in conventional petroleum-based Jute Batching Oil (JBO) can be a serious contaminant and have long been proven to be carcinogenic (Moret et al. 1997, Mehrotra et al. 1987, Agarwal et al. 1985).

Polythene plastic (in Ghana: '*fertiliser*') sacks should only be used for transportation or on other temporary basis, as these sacks do not allow for free circulation of air to regulate humidity. Diurnal temperature fluctuations can trap adequate moisture to support fungal bloom and infestation of shea kernel so stored.

It is important to stress that the first steps of production outlined above, from collection of the fresh fruit to drying of the kernel, are of critical importance to the final quality of the shea butter. If the shea kernels are of low quality, particularly as defined by high FFA and the presence of fungal contamination and/or other impurities, the quality of the shea butter extracted from them will require chemical refining to remove products resulting from lipid degradation in the kernel.

In some areas, insect infestation of dried shea kernel in storage is common, *e.g.* by larvae of the small brown tobacco moth *Ephestia elutella.* A number of traditional methods are employed to reduce the problems of infestation by insects or fungal attack, such as by admixture with ash or plant extracts. Subsequent ***washing*** of the dried kernel prior to processing (see below) may be sufficient to remove traces of these substances used during storage. However, as care must be taken to avoid contamination of the dried kernel, it is preferable to avoid insect contamination solely by regular inspection of the stored product, and removal of infested nuts through ***triage*** (see below).

During the latter half of the dry season (roughly February to April), moisture levels in the kernel may drop to below the threshold at which a powder can be obtained by pounding and sifting or by grinding / milling. In this case, sufficient humidity can be restored to the kernels by rinsing them just before extraction, without waiting for them to dry completely.

The most important quality aspect to consider at this stage is that once the surface area of the shea kernel has been increased in the flour the biochemical opportunities for degradation through oxidation or hydrolysis are increased, particularly if water or certain catalysts are present, including metal ions, ultra violet (UV) light (*i.e.* sunlight) and ambient heat.

Use of aluminum or iron pots in heating stages (wet or dry) may result in contamination of the final product by these toxic ions. The use of stainless steel for all processing stages is preferred.

Use of an engine-powered grinding mill may present risks of contamination with other crops, the presence of iron particles from the grinding plates and introduction of bad odours from the presence of diesel or lubrication oil. Maximum care must be taken to avoid contamination.

A paste is needed for the kneading method of manual extraction as practiced in West Africa, while a powder is required for hand-pressing as is common in eastern Africa, as well as the Central African boiling method.

A fine powder may also be obtained by manually by pounding kernel in a mortar and sifting the resulting 'flour', returning grains larger than desired back to the mortar.

According to some traditional artisanal extraction methods of northern Ghana, plant extracts of *Cochlospermum planchonii* and *C. tinctorium* are sometimes added at this stage, e.g. to change the colour of the final butter from white to yellow. While there is only speculation as to the chemical compounds involved, and whether there is any chemical (antioxidant or other) effect on shea butter so tinted, international buyers have lamented the uneven tone of the yellow butter as it ages, particularly evident in transparent containers.

The use of plant extracts of *Cochlospermum planchonii* and *C. tinctorium* shall be avoided as this causes uneven tone of yellow butter as it ages."

The duration ***Wet boiling***: should be minimised in order to reduce oxidative action, and (particularly for cosmetic and pharmaceutical applications) to preserve maximum levels of antioxidants and other bioactive compounds of the unsaponifiable lipid fraction.

Filter cloth should be carefully cleaned, rinsed and fully dried in a clean environment to avoid contamination of the product by rancid oil traces which may remain in the cloth. Use of common bar-soaps detergents to clean filter cloth may result in discoloration of the product if the filter cloth is not adequately rinsed and fully dried during cleaning.

On rural markets, balls of this creamy butter are cut into chunks, often presented in cold water to maintain solidity for sale – although any contact with water will certainly catalyse hydrolytic degradation of the product. Larger amounts are traditionally sold as balls or lumps inside calabashes or wrapped in leaves. This practice should not be encouraged.

Great care must be taken to avoid the use of recycled plastic containers for the storage of shea butter. In many cases, residual compounds (including, in some cases, petroleum products and even highly toxic pesticides) may easily contaminate the product. Even if containers have been carefully cleaned, surface scratches may harbour bacteria or other microbiological contaminants, and (as mentioned above) any trace of water will serve as a catalyst of hydrolytic degradation of the product, causing rancidity in a matter of days or weeks.

Implications of Processing Methods by Quality Parameter : toward a Standard Operating Procedure (SOP)

The following guidelines are provided as a summary reference toward development of a Standard Operating Procedures (SOP) for production and processing of shea kernel and shea butter of the highest quality, according to grading systems based on parameters of oil quality

Total (Available) Lipid Content (in Extraction)

1. The availability of kernel lipids in extraction may be enhanced by boiling of the fresh shea nuts. However, there may be quality costs in boiling, particularly as regards Peroxide Value.

Free Fatty Acid (FFA)

1. Nuts should be dried as rapidly as possible, preferably in a solar drier; if such technology is not available, care should be taken to protect the drying nuts from rain, and they should be stored so as to maximise circulation of air during the drying process.

2. Boiling of the fresh nuts tends to reduce FFA (as well as increasing available total fat content in extraction), but boiling can increase susceptibility to development of peroxides , possibly through reduction of phenolic antioxidant compounds in the kernel.

3. Once the kernel has been broken (thus increasing surface area exposed to oxidative degradation), all the stages of extraction should be carried out in sequence and as rapidly as possible.

4. Finally, the finished product should be handled carefully, stored in a sealed container, and protected from heat, light and exposure to water, air and any other contaminants.

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